# Utilizing Machine Learning to Generate Efficient Quantum Algorithms

Kang, Christopher (School: Hanford High School)

Quantum computing is a quickly growing field, as it provides a potentially crucial method towards tackling complex computational problems. By relying upon subatomic particles and principles of quantum mechanics, these computers can solve computationally expensive problems that would be untenable on classical computers. However, quantum computers have short decoherence times and other limitations that must be overcome to maximize performance. Moreover, physical quantum chips often have varying accessible gates, preventing the effective transfer of algorithms between quantum devices. The project aimed to overcome these hardware limitations by generating complex quantum gate sets through two different evolutionary algorithms. The first algorithm prioritized the I/O nature of the gate set, mimicking the inputs and outputs. The second algorithm searched for solutions that generated gate sets that produced a desired matrix manipulation. Both algorithms were successful, allowing for the efficient generation of a modified 4-qubit Bell state within a timely manner. After the evolutionary algorithms were executed, a new objective was identified: the automatic prediction of the number of gates necessary to achieve a net matrix transformation. By feeding two matrices, with the real and imaginary components of the probability amplitudes, neural networks could accurately predict the length of gate set necessary. Using these neural networks will allow quantum scientists to plan around decoherence times and adapt to increasingly complex quantum programs. Together, these tools enable quantum programmers to quickly develop quantum circuits through machine-learning techniques.

**Awards Won:**

American Statistical Association: Certificate of Honorable Mention